

CS352 Human-Computer Interaction Project

Navigating the Virtual Environment Using Microsoft Kinect

Requirements Documents

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Project Background

Virtual Environment is using computer-generated environment to represent the real world scenes or objects. It usually has an interactive system which will give users an illusion of displacement to another location. Some advanced VR system even includes tactile information which gives users force feedback. The applications of virtual environment are diverse, such as space exploration, combat training, psychophysical experiment, as well as entertainment.

A key feature of our virtual reality system is that we perform a walkthrough of a virtual environment from different views direction and orientations. The synthesis of the virtual environment and the moving of a virtual environment with six degrees of freedom are accomplished in our system.

System Perspective

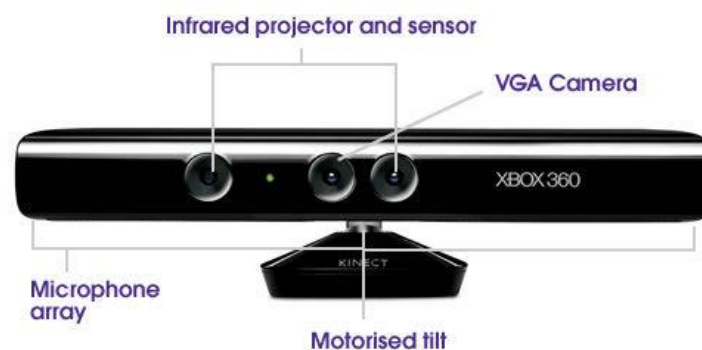


Figure 1. Microsoft Kinect XBOX 360

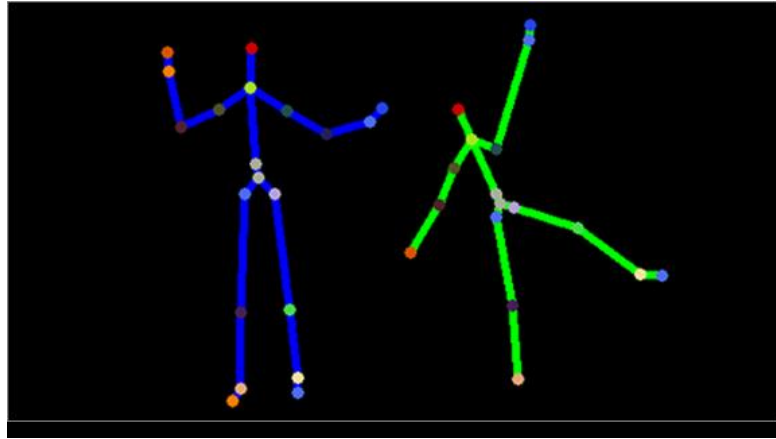


Figure 2. Kinect Skeleton Tracking

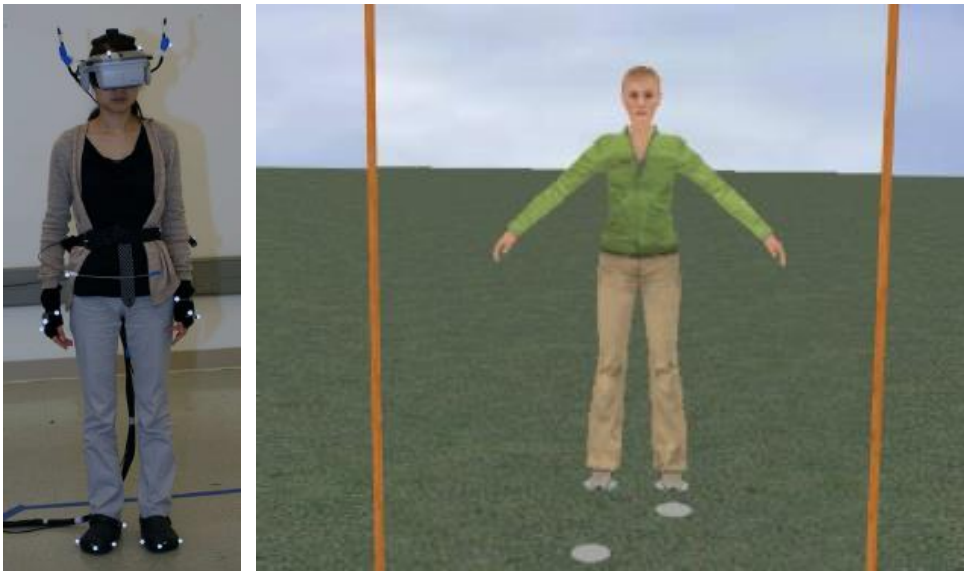


Figure 3. Head Mounted Display and Avatar in VE [1]

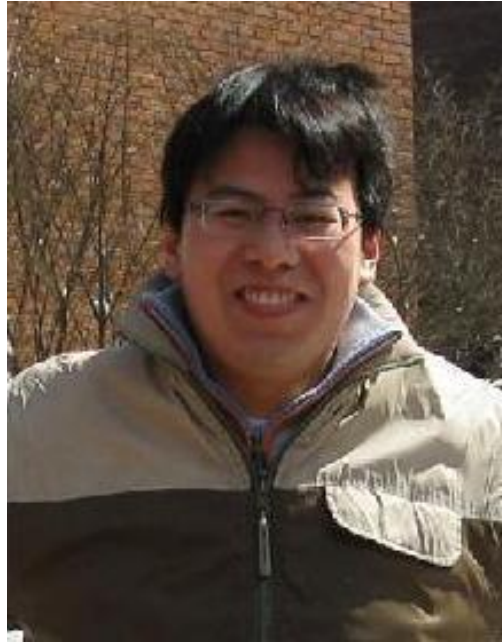
User Profile

Name:

Xianshi Xie

Gender:

Male



Background:

As a research assistant in Dr. Bobby Bodenheimer's lab, Xianshi is an expert in operating all the equipment in the virtual environment lab. He published many research papers related to virtual environment and he designed a mixed reality system for combining real robots, humans, and virtual robots.

Needs:

A robust, virtual environment navigation system which he can apply more experiments on.

Xianshi's Scenario

Xianshi is writing codes about his excellent virtual environment system, and he proposes an interesting experiment which will combine real robots humans, and virtual robots. The people who walk in the virtual environment needs to wear a head mounted display (HMD). The physical tracking space is in a certain area where is

surrounded by eight Vicon cameras. Those cameras can locate the accurate position of the people, tracking his moving forward, backward, turning and so on. This is the actual walking in virtual environment.

For the research purpose, he needs some similar experiments to compare the results. For example, using interfaces ranged from joystick-only, to linear and omnidirectional treadmills and actual walking in virtual environment. For joystick-only, people do not need to walk. They just stand still, and use joystick to move or turn around, just like playing video games. This is OK with the help of joystick. But for linear and omnidirectional treadmills, it's just marking time at the place without actually going forwards in the real world. So the eight Vicon cameras will not work since the physical position of the person does not change. However, using Microsoft Kinect can solve this problem. Kinect can capture user's motion and posture, even when people are marking time, it can capture it through the magic sensors. How cool it is!

Also, he can make a survey about the user feeling of the navigation in virtual environment with using Kinect or eight Vicon cameras, which one user may feel more comfortable than the other. The result may be valuable for Xianshi to improve his virtual environment system.

Name:

Fangzhou Sun

Gender:

Male



Background:

In his spare time, Fangzhou loves playing first player shooting (FPS) games, for example, counter-strike. He sort of gets crazy on the 3D computer games. He is familiar with the computer-generated environment and he did pretty good on navigating the virtual environment.

Needs:

Any kind of 3D navigation game or experiment, he used to play with traditional human-computer interaction tools, such as keyboard and mouse. This time, Fangzhou wants to try some new tools that will give him great experience he's never had before.

Fangzhou's Scenario

Fangzhou grows up with the immersion of computer games. He loves all kind of computer games, especially for those navigation games. When he was a little boy, his father bought him a computer. That's when he started his game life. He not just likes

to play computer games, but also he learns to write one. When Fangzhou was the age for college, he chose computer science as his major. At that time, he knows he cannot live without computer, perhaps also computer games.

In Fangzhou's game life, he used traditional keyboard and mouse to play all kinds of games. Although he is quite familiar with these interaction tools, he still wants to try some new play methods. In order to find them, he came to the United States, came to Vanderbilt University for a graduate degree. Now he finds it, the navigation of virtual environment. He could never think about one day he could get rid of those stupid keyboard and mouse, just wearing an awesome head mounted display, holding a wonderful joystick to experience the game. Standing in front a Kinect, he can make any pose, and turn any direction, which all will be captured by Kinect. This makes Fangzhou feel so realistic, with the head mounted display on the head. He could hardly tell which one is real, which is virtual.

The other big advantage Fangzhou realized is that, the Kinect is very portable and convenient. He could even take it home to play it, and it is not as expensive as other equipment in the lab. However, it is pretty powerful, not only capturing the posture, but also recognizing the sound. He can definitely enjoy himself navigating this virtual environment.

Inputs/Outputs

Our user-interface consists of several areas, which are skeleton view, camera view, and virtual environment view. Skeleton view shows the user's skeleton, which is shown by green lines to represent user's bone. Camera view is the ordinary view of user which is also captured by Kinect. The biggest area is virtual environment view, which is used to show the navigation of virtual environment (As Figure 4 shows). This is only shown on the computer monitor. The people who wear a HMD can only see the virtual environment view, which will make it more realistic.

User should stand in front of Kinect, and mark time at the same place without actually move forward. But the virtual environment did move forward. Kinect should be able to capture all the postures of people and reflect it in the virtual environment.

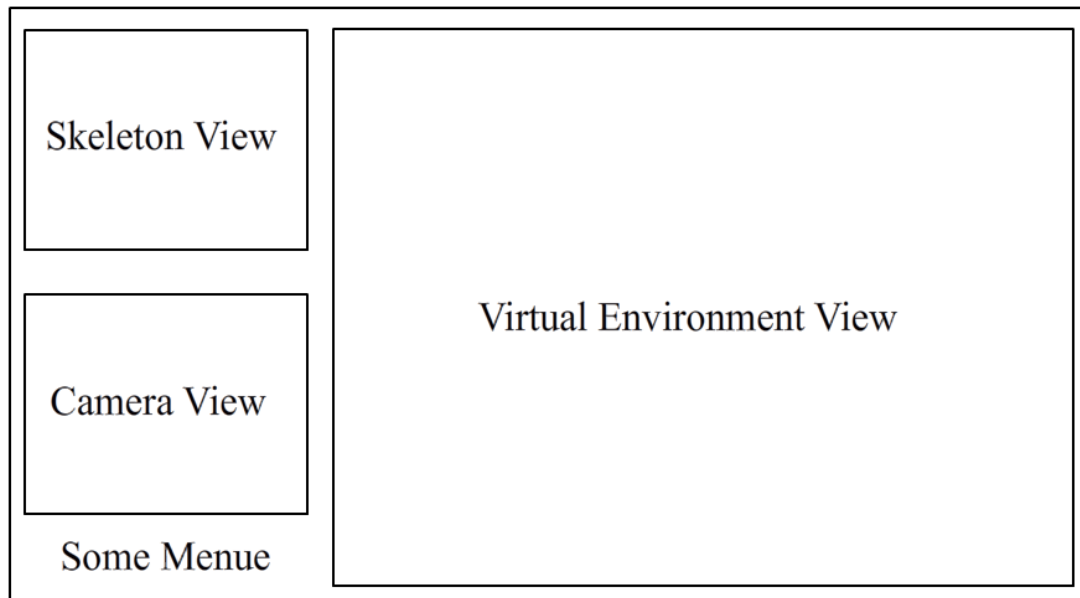


Figure 4. User-Interface Design

Constraints

- ✧ Users should feel refreshing, exciting or live to the VE, no negative feelings after they run the program.
- ✧ The project can only be used with the Microsoft Kinect and one HMD.
- ✧ The resolution of the project result is limited by the capability of the Kinect.
- ✧ The project is a single-user system.
- ✧ The project can only be developed with the currently available equipment in the Professor Bobby Bodenheimer's lab.
- ✧ The timeframe for the development of the project is about 3 months and definitely a longer timeframe is more reasonable.

Actual Requirements

In this project actual requirements include 5 categories: Function, Non-Functional (Data Requirements), Environmental (Context of Use), User (Operator), and Usability (Measurement), and below are Requirement lists of this project.

Requirement #1: UI

Requirement type: Function

Description: The project should enable users to easily run the VE, just one click away, and also just one click the project can enable users to select various VEs, such

as space exploration, combat training, psychophysical experiment, as well as entertainment.

Rationale: The UI should be robust and easy to use.

Source:

Fit Criterion: A test case or sets of tests will be used to validate.

Customer Satisfaction: N/A yet

Customer Dissatisfaction:

Dependencies:

Conflicts:

Requirement #2: Instructions

Requirement type: Function

Description: The PC screen should show simple instructions how to switch between two VE modes: WALK and FLY, after users run the program.

Rationale: The UI should be easy to use.

Source:

Fit Criterion: A test case or sets of tests will be used to validate.

Customer Satisfaction: N/A yet

Customer Dissatisfaction:

Dependencies:

Conflicts:

Requirement #3: Motion

Requirement type: Function

Description: Users can readily realize the behaviors required by the project.

Rationale: Users are always the first in the project design.

Source:

Fit Criterion: A test case or sets of tests will be used to validate.

Customer Satisfaction: N/A yet

Customer Dissatisfaction:

Dependencies:

Conflicts:

Requirement #4: UI Display

Requirement type: Non-Function (Data)

Description: This project requires a robust User Interface (UI) to be developed which contains following areas: About | Usage Description | Support | Report a Problem | Developers | Development Date

Rationale: UI should be enough to cover all necessary data for users.

Source:

Fit Criterion: A test case or sets of tests will be used to validate.

Customer Satisfaction: N/A yet

Customer Dissatisfaction:

Dependencies:

Conflicts:

Requirement #5: Hardware

Requirement type: Context of Use

Description: The project requires following devices: a personal computer, Microsoft Kinect and HMD. And the PC should be equipped 32-bit (x86) or 64-bit (x64) processor, with processing speed as duo-core 2.66 GHz or faster, dedicated USB 2.0 and 2 GB RAM. The OS should be Windows 7, Windows Embedded Standard 7, Windows Embedded POSReady 7, or Windows 8 Operating System. And the PC should have Internet access.

Rationale: Hardware is essential to realize the whole project.

Source:

Fit Criterion: As required by the Microsoft website.

Customer Satisfaction: N/A

Customer Dissatisfaction:

Dependencies: N/A

Conflicts: N/A

Requirement #6: Software

Requirement type: Context of Use

Description: Kinect for Windows SDK can be downloaded via the Microsoft website and the Integrated Development Environment (IDE) should be Microsoft Visual Studio 2010. *Rationale:* Software is same essential to realize the whole project.

Source:

Fit Criterion: As required by the Microsoft website.

Customer Satisfaction: N/A

Customer Dissatisfaction:

Dependencies: N/A

Conflicts: N/A

Requirement #7: Ordinary Users

Requirement type: User

Description: This project is designed in the game area to face the public.

Rationale: The public always is our target users.

Source:

Fit Criterion: Guided by the project design principles

Customer Satisfaction:

Customer Dissatisfaction:

Dependencies:

Conflicts:

Requirement #8: Test

Requirement type: Usability

Description: Several sets of WALKs and FLYs should be used to test if the program developed is robust

Rationale: Further improve the program developed.

Source:

Fit Criterion: Guided by the project design principles

Customer Satisfaction: N/A yet

Customer Dissatisfaction:

Dependencies:

Conflicts:

Requirement #9: Update

Requirement type: Context of Use

Description: The program developed for this project should be updated when both software and hardware mentioned in the Requirements #5 and #6 are updated.

Rationale: To keep the program updated otherwise it won't be useful any more in the future

Source:

Fit Criterion: The program should keep up with the technology advancements

Customer Satisfaction:

Customer Dissatisfaction:

Dependencies:

Conflicts: Requirement #5 & #6 in the future

Project Time Line

For the whole project, since obviously the gesture recognition is divided into two modes: WALK and FLY, and these two modes are assessed as same level of workload. Xiaochen Yang will work on the codes of the WALK recognition and Lichuan Pan will work on the FLY. The whole code development will start from the second week of September 2013 and will be finished by October 2013 and the code evaluation will be finished by November 2013. Below are the steps to finish the project (change the week plan to exact dates).

Steps for the design and prototype:

1. Hardware and software environment Setup, 09/07 - 09/14/2013
2. Software work flow and initialization for the project, 09/15 - 09/21/2013
3. Coding the gesture recognition, 09/22 - 10/12/2013
4. Interface design and integration of WALK and FLY, 10/13 – 10/19/2013
5. Finish the prototype, 10/20 – 10/26/2013

Steps for Evaluation:

1. Come up with several tasks, several sets of gestures including WALKs and FLYs, to test the prototype, 10/27 – 11/16/2013
2. Finalize software development of the project, 11/17 – 11/23/2013

Honor Code

Xiaochen Yang and Lichuan Pan have neither given nor received unauthorized help on this Project Plan

References

[1]. Qiufeng Lin, Xianshi Xie, Aysu Erdemir, Gayathri Narasimham, Timothy P. McNamara, John Rieser, and Bobby Bodenheimer. 2011. Egocentric distance perception in real and HMD-based virtual environments: the effect of limited scanning method. In *Proceedings of the ACM SIGGRAPH Symposium on Applied Perception in Graphics and Visualization (APGV '11)*, Stephen N. Spencer (Ed.). ACM, New York, NY, USA, 75-82.